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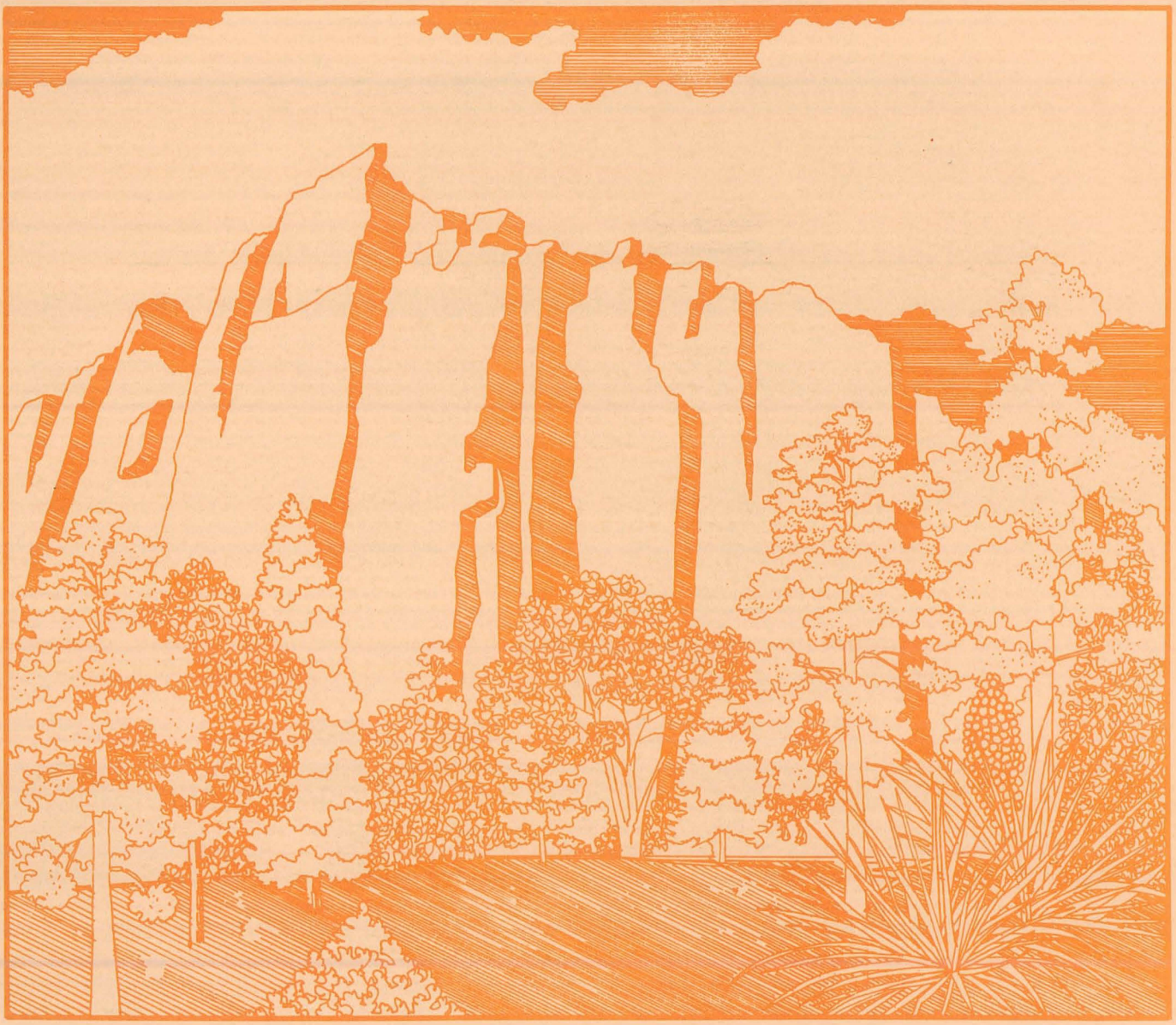
Forest Pest Management Report

R-3 82-3

BIOLOGICAL EVALUATION
Western Spruce Budworm

Carson National Forest
and Taos Indian Pueblo
New Mexico

December 1981



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Forest Pest Management
State and Private Forestry
Southwestern Region, USDA, Forest Service
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ABSTRACT

The western spruce budworm, Choristoneura occidentalis Free., continued to defoliate mixed conifer stands on both divisions of the Carson National Forest, Taos Pueblo Indian Reservation, and adjoining lands. In 1981, a total of 135,025 acres of host type was defoliated.

Average egg mass densities on both the Taos and Questa entomological units declined substantially from those recorded last year. However, remaining egg masses are still sufficiently high and indicate that defoliation on both units in 1982 will continue at levels similar to that of last year. Heaviest defoliation occurred and will continue to occur along the Rio Fernando de Taos and around Palo Flechado Pass on the Taos unit, and along Red River, Cabresto Creek, and both sides of Hondo Canyon in the Questa unit.

Defoliation on the Tres Piedras and El Rito Ranger Districts (Tres Piedras entomological unit) is expected to increase in area and intensity during 1982.

The western spruce budworm outbreak is expected to continue for several more years on the Carson National Forest, Taos Pueblo Indian Reservation, and adjacent lands of mixed ownership.

Pest management alternatives and recommendations are presented and discussed in this evaluation report.

INTRODUCTION

The western spruce budworm, Choristoneura occidentalis Free., continued to defoliate mixed conifer stands on the Carson National Forest and adjacent lands in 1981. Visible defoliation 1/ was first reported on the Taos and Questa entomological units in 1975 and 1976, respectively. Defoliation was next aerially detected on the El Rito and Tres Piedras Ranger Districts (Tres Piedras entomological unit) for the first time in 1980. Since 1976, total acres defoliated on the Forest and adjoining lands were 21,760, 40,200, 15,039, 30,542, and 108,450, respectively. In 1981, 135,025 acres were defoliated.

Egg mass surveys were conducted on the Taos, Questa, and Tres Piedras entomological units and are summarized in this evaluation. Management alternatives and recommendations are also presented.

TECHNICAL INFORMATION

Insect.--Western spruce budworm, Choristoneura occidentalis Freeman

Host.--Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. and Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry.

Life History.--The western spruce budworm completes one generation each year (Furniss and Carolin 1977).

Stage	Time	Location on Host
Egg	August	On needles
Small larvae	Overwinter	In hibernaculum (silken cocoons) on branches and trunk
Large larvae	June	On buds and strobile
Pupae	July	On foliage
Adults	August	In flight

Evidence of Infestation

1. Young larvae feeding on newly expanding buds and strobile.
2. Mature larvae consuming current year's needles.

1/ Visible defoliation based on the aerial detection survey.

3. Shoots webbed together by larvae.

4. Webbed shoots turning brown and falling from trees.

5. Defoliation most evident in upper crowns of trees.

6. Trees dying from top downward after several years of heavy defoliation.

Extent of Defoliation in 1980.--Defoliation was visible from the air on 135,025 acres of the Carson National Forest and adjoining lands. Severity of defoliation was categorized as: light, 18,525 acres; medium, 81,975 acres; and heavy, 34,525 acres. Defoliation by separate ownerships is as follows:

	L	M	H
Carson National Forest	16,575	52,900	27,775
Taos Pueblo Indian Reservation	1,175	26,600	4,950
Other adjoining lands	775	2,475	1,800

Defoliation continued to increase in area and intensity Forest-wide. Areas with noticeable increases occurred north of the Rio Fernando de Taos highway, along the east side of the Taos entomological unit between Palo Flechado and Osha Passes, and along the north and south sides of Red River and Cabresto Creek. Defoliation also increased substantially on the Tres Piedras and El Rito Ranger Districts, with new areas of defoliation detected on Tusas Mountain and in Long Canyon (Tres Piedras Ranger District) and in Kiowa Canyon, Borracho Canyon, and Jarita Canyon (El Rito Ranger District). Figures 1-4 show the extent and intensities of defoliation that occurred on the Taos, Questa, Tres Piedras, and El Rito Ranger Districts, and adjoining lands, respectively.

BIOLOGICAL INFORMATION

Relative Abundance of Pest

Methods.--Egg mass surveys were conducted in August to provide an indication of larval densities and corresponding defoliation expected to occur in 1982. Samples were taken from 45 plots in the Questa, Taos, and Tres Piedras entomological units. Two branches (70 cm in length) were cut from opposite sides of the midcrown of three sample trees on each plot. Sample trees met the following criteria: Douglas-fir, dominant or codominant; 30-50 feet in height; relatively open grown with a full crown; and some budworm feeding evident, but the tree could not be severely defoliated or top-killed.

Each branch was individually bagged in 1/4-bushel cloth bags, tied, labeled, and transported to a laboratory for examination. All sacks were stored in a walk-in cooler at about 40° F.

In the laboratory, the foliage was examined under ultraviolet light for budworm egg masses. Needles bearing egg masses were classed as from current year's foliage, or a previous year's foliage, and kept separate in labeled pill boxes. Egg masses were separated as new or old by an experienced laboratory technician. All egg masses on current year's foliage were classed as new, and their characteristics formed the basis for aging egg masses found on previous year's foliage.

Defoliation predictions for 1982 were determined from the density of 1981 egg masses using the following information presented by McKnight et al. (1970):

Egg mass density a/	Predicted defoliation class b/
<1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations
9.30 to 31	Light for "static" infestations Moderate for "increasing" infestations
>34.10	Moderate for "static" infestations Heavy for "increasing" infestations

a/ Number of egg masses per square meter of foliage.
b/ Defoliation class limits (percent of new growth).
Undetectable = <5 percent
Light = 5 to 35 percent
Moderate = 35 to 65 percent
Heavy = >65 percent

Results.--Results of the 1981 egg mass surveys conducted on the Carson National Forest are presented separately for each entomological unit and are summarized in table 1.

Taos Entomological Unit. This unit includes the Taos Ranger District, Taos Pueblo Indian Reservation, and adjoining privately owned lands. The average egg mass density on this unit decreased from 50.6 to 14.1 egg masses per square meter of foliage; however, this level is still high enough for budworm larval populations to continue to cause moderate to heavy defoliation in 1982. Egg mass densities per square meter of foliage ranged from 3.3 near Baca Canyon to 27.1 at La Sombra Campground (figure 1).

Defoliation was heaviest along both sides of the Rio Fernando de Taos from Cruz and Ranchos Canyons east to Palo Flechado Pass.

In addition, egg mass surveys were also conducted south of the Fernando Mountains along Forest Service Road No. 437 where low-level budworm larval populations were confirmed for the first time earlier this year (reference our 3430 letter of July 1, 1981). Egg mass densities along Forest Service Road No. 437 averaged 1.9 egg masses per meter square of foliage. These data indicate that populations south of the Fernando Mountains will occur at low levels with light defoliation in 1982.

Questa Entomological Unit.--Egg mass densities on this unit averaged 31.3 egg masses per square meter of foliage and indicate that budworm populations will remain at relatively high levels in 1982. Heavy and moderate defoliation continued to occur along both sides of the Red River Canyon from Goat Hill Campground east to the Red River Ski Area, and along both sides of Cabresto Creek Canyon from Eagle Rock east to Rito Clara Creek and Sawmill Mountain. Moderate to heavy defoliation also occured along both sides of Hondo Canyon from Cuchillo del Medio to the Taos Ski Area.

Tres Piedras Entomological Unit.--This unit includes both the Tres Piedras and El Rito Ranger Districts. Egg mass densities on this unit averaged 34.3 egg masses per square meter of foliage. This represents a 2.2 increase in numbers of egg masses over last year and indicates that insect densities and defoliation will increase substantially on both Districts next year. Primary areas of defoliation occurred near Tusas Mountain (Tres Piedras Ranger District) and at Laguna Chico and Cholejo Spring (El Rito Ranger District, refer to figures 3 and 4, respectively).

Discussion and Prediction of Trend

The western spruce budworm outbreak on the Taos and Questa entomological units (figures 1 and 2) is expected to continue at moderate and heavy levels in 1982. Although egg mass densities show ratios of less than one from 1980 to 1981, average egg mass densities indicate that insect populations will remain sufficiently high to cause moderate to heavy defoliation on both of these units in 1982. With the expansion of the infestation along the east side from Palo Flechado Pass north to Taos Peak, the Questa and Taos entomological units have become one contiguous infestation. Barring any natural factor(s) that could bring about the collapse of the infestation, it is expected to continue to increase in area and intensity on the Carson National Forest, Taos Pueblo Indian Reservation, and adjoining privately owned lands for several more years. Heaviest defoliation and tree damages will continue to occur along the Rio Fernando de Taos, Palo Flechado Pass, and Rio Puerco de Taos on the Taos unit; and along Red River, Cabresto Creek and Hondo Canyons on the Questa unit.

Areas of light and moderate defoliation will continue to expand on both the Tres Piedras and El Rito Ranger Districts in 1982.

MANAGEMENT ALTERNATIVES

No Action.--With this approach, the outbreak would be allowed to run its course until a population collapse occurred from a combination of: (a) a lack of foliage to maintain a larval population; (b) unfavorable weather conditions; (c) heavy predation and parasitism; and (d) a microbial epizootic. Adverse and beneficial effects of the outbreak would have to be accepted. These are:

1. This alternative would not be effective in preventing additional tree damages. Impacts to resource values and uses caused by the budworm would have to be accepted under this alternative. Although damages resulting from the western spruce budworm in the Southwest are currently unknown, maximum damages similar to those estimated for the Pacific Northwest could occur if the outbreak continues unabated. These include the following:

Tree damages	Maximum damages (percent)
Growth loss	30
Understory mortality	25
Sawtimber mortality	5
Top-killing	25
Cone crop reduction	90+
Christmas tree use reduction	90+

2. There would be no direct costs associated with selection of this alternative, although timber values will be affected and revenues reduced when severely damaged stands are harvested. Also, the depletion of the understory could necessitate the expenditure of funds for reforestation.

3. Visual qualities and economic and social impacts would result if this alternative were selected.

Silvicultural Management.--The main objective of this alternative is to promote effective timber management of the mixed conifer type. The pest management component of this alternative is to create stand conditions that reduce tree damages over the long-term. For example, prescriptions should: (a) open up stands by logging, thinning, and burning; (b) maintain stand densities favoring ponderosa pine and aspen; (c) favor prescribed burning to reduce the percentage of firs and Engelmann spruce; (d) regenerate stands by artificial means using ponderosa pine stock; (e) favor even-aged stands; and (f) salvage damaged and insect-killed trees.

Effects of this alternative are:

1. The trend of the current outbreak would not be changed if a silvicultural program were initiated. Tree damages would be the same as those listed under the "Maintain Present Management" alternative.

2. Visual qualities and economic and social impacts would result if this alternative were selected.

Direct Suppression.--Aerial application of a pesticide registered by the U. S. Environmental Protection Agency (EPA) could be done to suppress all or part of the outbreak on the Forest. However, if only part of the infestation is treated or if adjoining lands are not treated, one or two additional treatments may be required during the infestation cycle since treated stands could be reinfested from nearby areas that were not treated.

Application would be carefully timed to the development of the larvae, i.e., when 20 percent of the larvae are in the fifth and sixth instars. This would insure maximum effectiveness with a minimum dosage of insecticide. An application of this type is designed to utilize indigenous natural control agents to further reduce and maintain the budworm population at a low level.

Effects of this alternative are:

1. If a direct suppression program were to be carried out on the Forest in 1982, tree damages and losses could be reduced in areas where permanent tree damages have not yet occurred. However, once permanent tree damages have occurred, the direct suppression alternative may no longer be practical.

2. Although there would be immediate costs associated with the application of a pesticide, about $10 per acre, positive benefits could be achieved by preventing additional effects to timber and recreational activities.

3. Adverse environmental effects resulting from the application of a pesticide would be minimal and temporary.

Insecticides registered for use against the budworm follow:

1. Carbaryl (carbamate insecticide)

The Sevin® 4 oil formulation of carbaryl has given consistently satisfactory results in suppressing budworm outbreaks throughout the West. An outbreak on the Santa Fe National Forest, New Mexico, was successfully suppressed in 1977, and the outbreak has remained at a low level for 4 2/ years (Parker and Ragenovich 1980). Carbaryl is a nonpersistent pesticide which is available for general use. One (1) pound of active ingredient per acre is the registered dosage rate, and no lasting environmental effects have been identified at this application rate.

2/ 1980 field data unpublished.

2. Acephate (organophosphate insecticide)

Orthene® is a nonpersistent insecticide registered for use against the western spruce budworm and other forest defoliators. Although this insecticide has been shown to be effective against the budworm, it has never been used in the Southwest.

3. Malathion (organophosphate insecticide)

Malathion is a nonpersistent, broad-spectrum insecticide, registered for use against more than 100 insects, including the western spruce budworm. However, it is not recommended because it has yielded inconsistent results in suppressing outbreaks.

4. Microbial Insecticides

Microbial insecticides such as Bacillus thuringiensis Berliner (B.t.), a bacterium, and viruses need further testing and field evaluation before they are ready for use. In 1981, two B.t. formulations were pilot tested by the USDA Forest Service and New Mexico Departments of Agriculture and Natural Resources near Eagle Nest, New Mexico. Preliminary results show that larval mortality was greater in sprayed areas than in check blocks. If treatment is necessary, B.t. could be used in sensitive areas, such as along waterways and near lakes, and near specific wildlife areas, etc.

Treatment of High Value Trees.--In recreation areas, VIS Centers, and other areas where defoliation of high value trees would be unacceptable, individual or small groups of budworm-infested trees could be treated by a ground application of an EPA-registered insecticide to reduce the larval density and prevent the adverse effects of defoliation.

Effects of this alternative are:

1. Because only selected high value trees within an infestation could be treated, this would require a number of applications during the outbreak cycle since treated trees would be reinfested from the nearby infestation.

2. Application costs associated with this alternative would have to be accepted.

3. Adverse environmental effects would be minimal and temporary.

RECOMMENDATIONS

Management of the Current Western Spruce Budworm Outbreak

1. Short-term Pest Management.--Direct suppression of the entire outbreak on either the Taos or Questa entomological units is not recommended. Based on current information, it appears that this alternative would be operationally ineffective and economically unsound. However, a partial treatment program is recommended where recreational and esthetic values must be preserved and/or where management objectives are threatened. Such areas should be examined on an individual basis to determine if suppression would be effective. It must also be realized that partial treatment may only be effective for a short period of time, possibly 2 years. A combination of chemical pesticides and B.t. is recommended for use if a partial treatment program is implemented. The majority of the areas warranting treatment should be treated with chemical pesticides and sensitive areas with B.t.

Direct suppression is recommended for infestations on the Tres Piedras and El Rito Ranger Districts (Tres Piedras entomological unit). Infestations on this unit are new and permanent tree damages have not yet occurred; however, tree damages will begin to occur in several years if the infestations continue at present levels. As with partial treatment, the majority of these infestations should be treated with chemical pesticides and sensitive areas with B.t.

2. Long-term Pest Management.--Long-term silvicultural management for western spruce budworm can be accomplished by including pest management considerations into timber and fire management programs. For example, management programs should facilitate the removal of susceptible old growth and favor ponderosa pine, Douglas-fir, and aspen in vigorous mixed conifer stands.

No recommendations have been made for the Taos Indian Pueblo lands.

REFERENCES

Furniss, R. L., and V. M. Carolin. 1977. Western forest insects. USDA, Forest Serv. Misc. Publ. No. 1339. 654 pp.

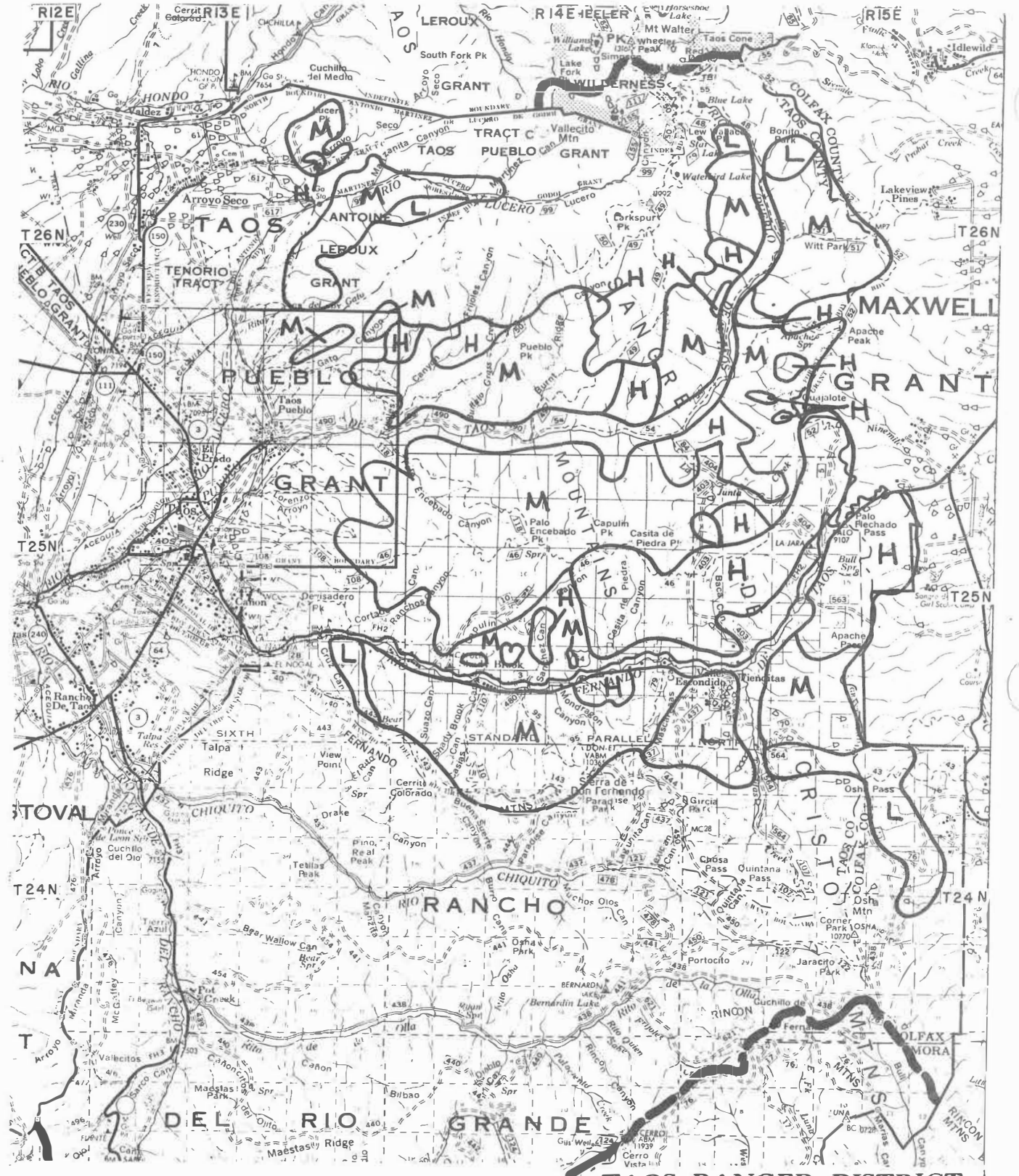
McKnight, M. E., J. F. Chansler, D. B. Cahill, and H. W. Flake, Jr. 1970. Sequential plan for western spruce budworm egg mass surveys in the central and southern Rocky Mountains. USDA, Forest Serv. Res. Note RM-174. 5 pp.

Parker, Douglas L., and Iral R. Ragenovich. 1980. Western spruce budworm suppression and evaluation project using carbaryl, 1979. USDA, Forest Serv. Progress Rep. No. 3. R-3 80-1. 56 pp.

'e 1. Summary of the egg mass and aerial detection surveys on the Taos, Questa, and Tres Piedras entomological units.

Taos Entomological Unit		1976	1977	1978	1979	1980	1981
New egg masses/sq. m foliage		38.3	22.3	36.3	42.8	50.6	14.1
Egg mass density ratio [a/]		1.7:1	0.6:1	1.6:1	1.2:1	1.2:1	0.3:1
Actual defoliation [b/] (acres)	L	9,400	15,040	2,725	6,477	31,200	6,375
	M	6,600	10,800	2,790	9,191	26,750	41,125
	H	560	0	4,250	282	6,975	15,775
Questa Entomological Unit							
New egg masses/sq. m foliage			9.9	17.9	43.1	47.6	31.3
Egg mass density ratio [a/]			3.4:1	1.7:1	2.4:1	1.1:1	0.7:1
Actual defoliation [b/] (acres)	L	1,900	13,080	2,560	3,174	22,850	4,800
	M	300	960	2,330	5,197	15,550	39,700
	H	0	320	384	6,221	3,275	18,550
Tres Piedras Entomological Unit							
New egg masses/sq. m foliage						15.8	34.3
Egg mass density ratio [a/]						---	2.2
Actual defoliation [b/] (acres)	L					550	7,350
	M					0	1,150
	H					0	200

a/ Egg mass density ratio is the ratio of new egg masses in the survey year to new egg masses of the previous year.
b/ Actual defoliation as determined from aerial detection survey, L = light, M = moderate, H = heavy.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FERNANDO
CHIQUITO
RINCON MTNS
COLFAX COUNTY
Mt Walter
Taos Cone
Wheeler Peak
South Fork Pk
Cuchilla del Medio
Arroyo Seco
Lucero Pk
Vallecito Mtn
Blue Lake
Lake Fork
Bonito Park
Lakeview Pines
Larkspur Pk
Witt Park
Apache Peak
Pueblo Pk
Taos Pueblo
El Prado
Ranchos De Taos
Capulin Pk
Casita de Piedra Pk
Palo Encebado Pk
Palo Flechado Pass
Talpa Ridge
View Point
Cerrito Colorado
Sierra de Don Fernando
Paradise Park
Pino Real Peak
Tetilla Peak
Cuchilla del Oso
Chosa Pass
Quintana Pass
Osha Mtn
Corner Park
Osha Park
Bear Wallow Can
Fot Creek
Portocito
Jaracito Park
Bernardin Lake
Cuchilla de la Olla
Valecitos
Maestas Park
Bilbao
Maestas Ridge
Cerro Vista
Rio Pueblo
Arroyo Hondo
Cañon Creek
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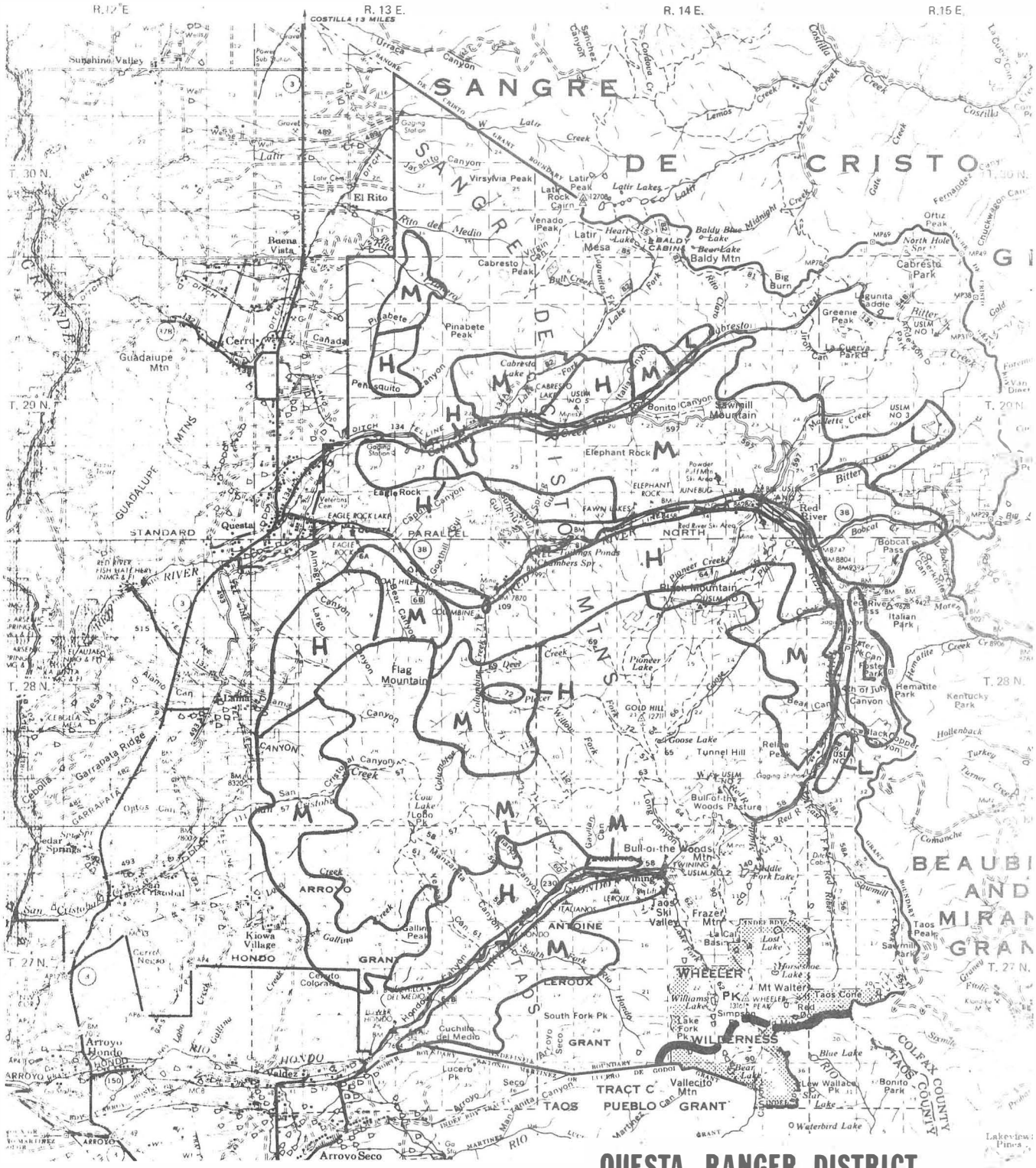
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Baldy Midnight Lake
Heart Lake
Bear Lake
Venado Peak
Virsylvia Peak
Cabresto Peak
Cabresto Lake
Cabresto Park
Pinabete Peak
Pinabete Canyon
Guadalupe Mtn
Cerro Canadas
Penasquito Canyon
Bonito Canyon
Sawmill Mountain
Elephant Rock
Eagle Rock
Eagle Rock Lake
Questa
STANDARD PARALLEL
RIO GRANDE RIVER
RED RIVER NORTH
Red River
Bobcat Pass
Pioneer Creek
Black Mountain
Italian Park
Hematite Park
Kentucky Park
Flag Mountain
Columbine Creek
Goose Lake
Tunnel Hill
Gold Hill
Pioneer Lake
Bull-of-the Woods Mtn
Bull-of-the Woods Pasture
Middle Fork Lake
Lost Lake
Frazer Mtn
Taos Ski Valley
Taos Peak
Sawmill Park
Horseshoe Lake
Mt Walter
Wheeler Pk
Williams Lake
Lake Fork Pk
Simpson
South Fork Pk
Cuchilla del Medio
Gallina Peak
Cerro Colorado
Kiowa Village
HONDO
ARROYO HONDO
Arroyo Hondo
Valdez
Arroyo Seco
Lucero Pk
Vallecito Mtn
Blue Lake
Lew Wallace Pk
Bonito Park
Waterbird Lake
Garrapata Ridge
Cebolla Mesa
Cedar Springs
Cerro Negro
Cerro Montoso
Cerro Chiflo
Cerro Pelon
Cerro Resumidero
Cerro Tres Orejas
Cerro Tres Lagunas
Cerro Tres Piedras
Cerro Tres Ojos
Cerro Tres Cruces
Cerro Tres Picos
Cerro Tres Peñas
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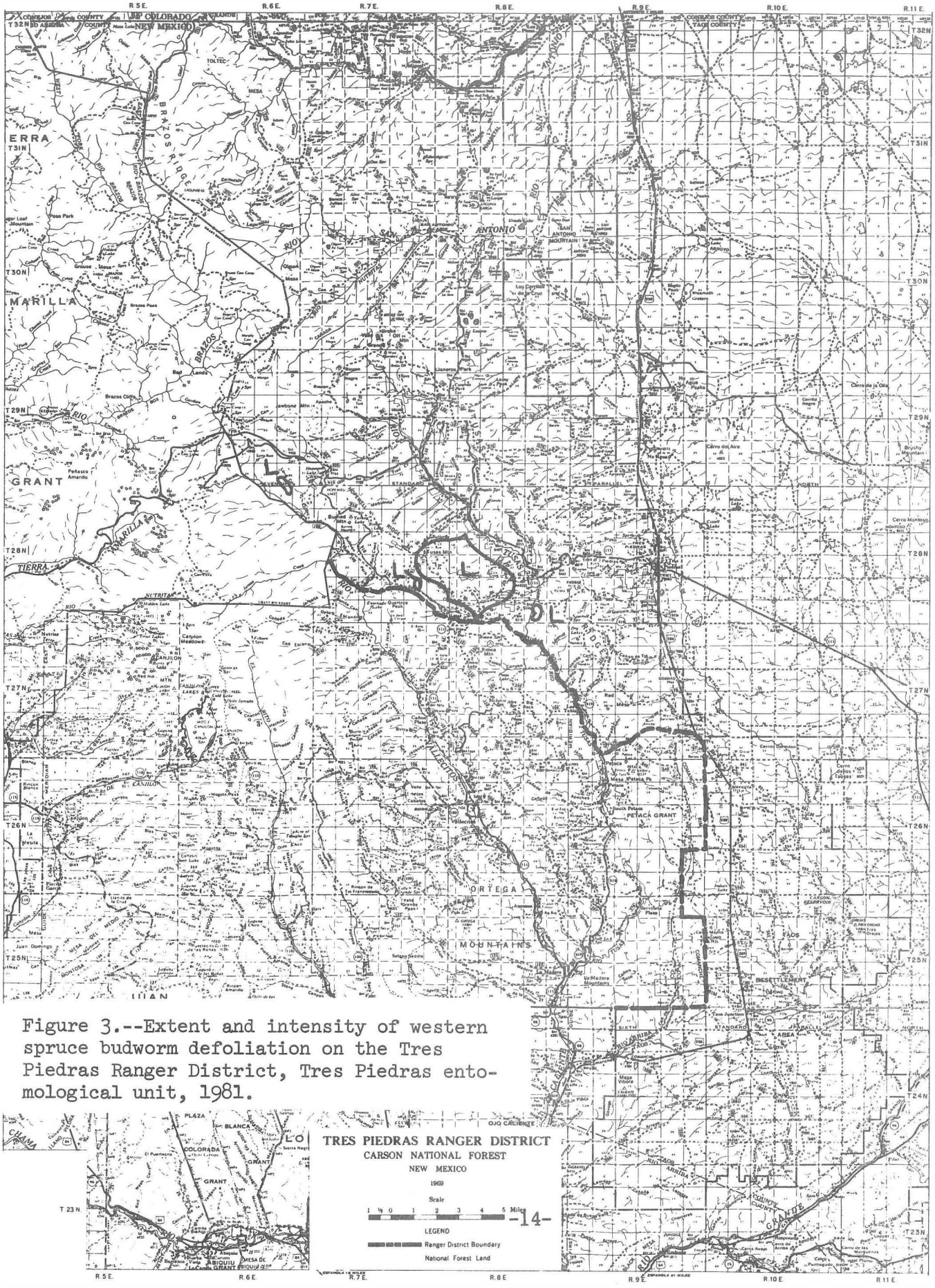

Figure 3.--Extent and intensity of western spruce budworm defoliation on the Tres Piedras Ranger District, Tres Piedras entomological unit, 1981.

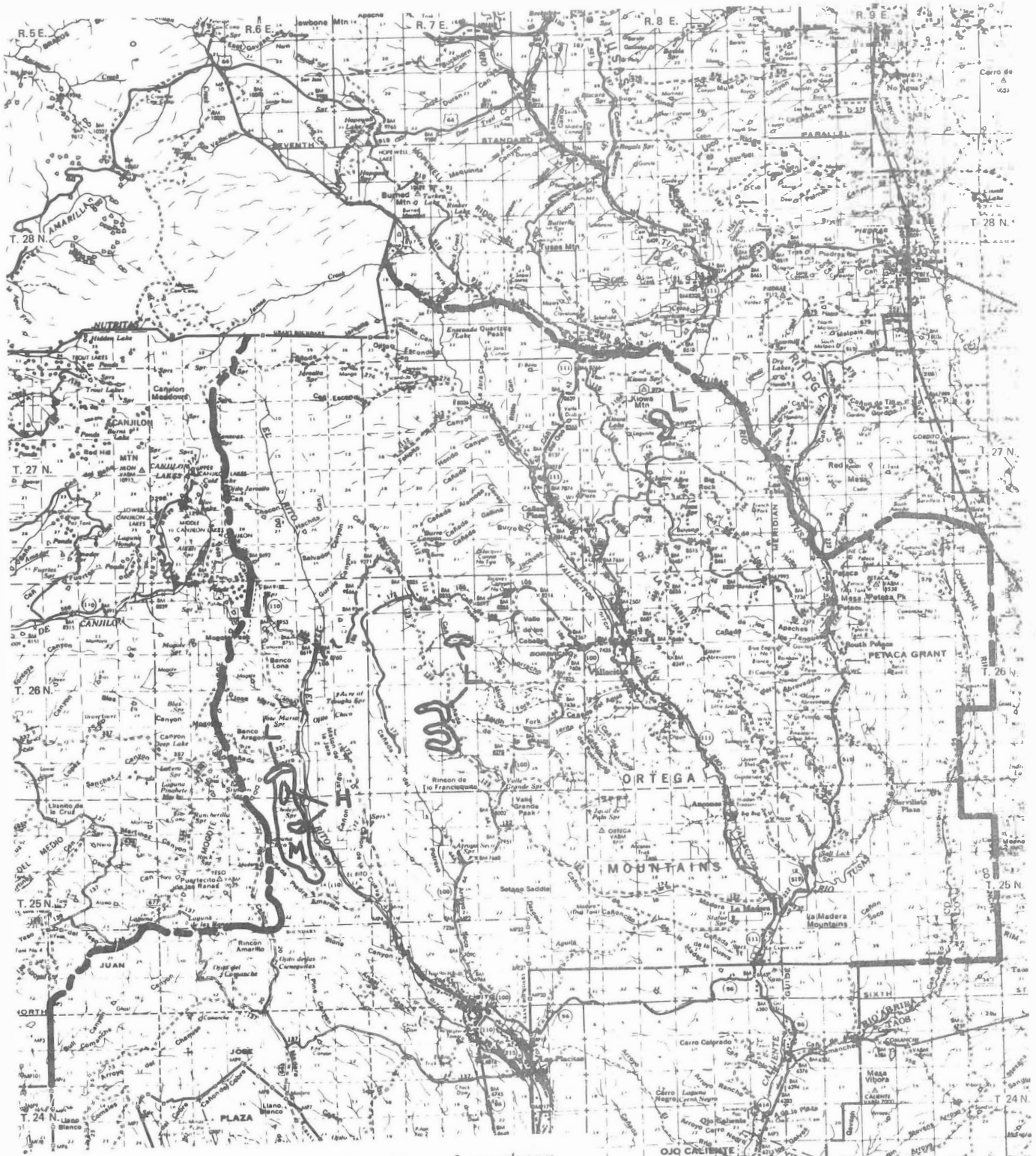

Figure 4.--Extent and intensity of western spruce budworm defoliation on the El Rito Ranger District, Tres Piedras entomological unit, 1981.